Listing of Claims

1. (Previously Presented) An overlay mark for determining a relative shift between two or more successive layers of a substrate, the overlay mark comprising:

at least one test pattern for determining the relative shift between a first and a second layer of the substrate in a first direction, the test pattern having a first set of working zones and a second set of working zones, the first set being disposed on a first layer of the substrate and having at least two working zones diagonally opposed and spatially offset relative to one another, the second set being disposed on a second layer of the substrate and having at least two working zones diagonally opposed and spatially offset relative to one another, each of the working zones having a periodic structure positioned therein, each of the periodic structures including a plurality of coarsely segmented elements that are formed from a plurality of finely segmented elements.

2. (Previously Presented) The overlay mark as recited in claim 1 wherein an image of the test pattern is captured via an imaging tool and an analysis algorithm is used to calculate the relative displacement of the working zones from the captured images.

3. (Original) The overlay mark as recited in claim 1 wherein the first set of working zones is angled relative to the second set of working zones.

4. (Previously Presented) The overlay mark as recited in claim 1 wherein the working zones are positioned within a perimeter of the mark.

5. (Previously Presented) The overlay mark as recited in claim 4 wherein the perimeter of the mark corresponds to an optical perimeter of a field of view of a metrology tool used to image the overlay mark, the field of view defining the area available for capturing an image via the metrology tool.

6. (Original) The overlay mark as recited in claim 5 wherein the working zones substantially fill the perimeter of the mark.

7. (Original) The overlay mark as recited in claim 1 wherein the working zones are spatially separated from one another so that they do not overlap portions of an adjacent working zone.

8. (Previously Presented) The overlay mark as recited in claim 1 wherein the working zones are configured to diminish an impact of non-uniformities across the mark on tool and wafer induced shifts.

9. (Cancelled)

10. (Currently Amended) The overlay mark as recited in claim [9] 1 wherein the pitch, period and duty cycle of the coarsely segmented elements is are configured to balance the resolution of the a metrology used to image the overlay mark and the robustness of the process used to form the layers.

11. (Currently Amended) The overlay mark as recited in claim [9] 1 wherein the coarsely segmented elements are parallel lines.

12. (Currently Amended) The overlay mark as recited in claim [9] 1 wherein the relative shift between the first and second layers of the a wafer is determined by comparing the relative positions of periodic structures on different layers.

13. (Cancelled)

14. (Previously Presented) The overlay mark as recited in claim 13 wherein finely segmented elements are configured to provide shift information that more closely matches the relative shift between patterns of an integrated circuit formed on each of the two layers of the substrate.

15. (Original) The overlay mark as recited in claim 1 further comprising a second test pattern for determining the relative shift between a first and a second layer of the substrate in a second direction.

16. (Original) The overlay mark as recited in claim 15 wherein the second test pattern is orthogonal to the first test pattern.

17. (Original) The overlay mark as recited in claim 16 wherein the first direction corresponds to the X-direction and the second direction corresponds to the Y-direction.

18. (Original) The overlay mark as recited in claim 15 further comprising a third test pattern and a fourth test pattern for determining the relative shift between a first and a second layer of the substrate in the first and second directions, respectively.

19. (Original) The overlay mark as recited in claim 1 wherein the first layer is disposed directly above or below the second layer.

20. (Previously Presented) An overlay mark for determining the a relative shift between two or more successive layers of a substrate via an imaging device configured for capturing an image of the overlay mark, the overlay mark comprising:

a first set of working zones disposed on a first layer of the substrate and having at least two working zones diagonally opposed to one another and positioned within the a perimeter of the mark, each of the working zones having a periodic structure of coarsely segmented elements positioned therein, the coarsely segmented elements being oriented in a first direction and formed from a plurality of finely segmented elements; and

a second set of working zones positioned crosswise relative to the first set of working zones, the second set of working zones being disposed on a second layer of the substrate and having at least two working zones diagonally opposed to one another and positioned within the perimeter of the mark, each of the working zones having a periodic structure of coarsely segmented elements positioned therein, the coarsely segmented elements being oriented in the first direction and formed from a plurality of finely segmented elements.

21. (Previously Presented) The overlay mark as recited in claim 20 wherein the perimeter of the mark corresponds to the an optical perimeter of the a field of view of the imaging device used to image the overlay mark, the field of view defining the area available for capturing the image of the overlay mark.

22. (Original) The overlay mark as recited in claim 21 wherein the working zones substantially fill the perimeter of the mark.

23. (Original) The overlay mark as recited in claim 20 wherein the working zones are spatially separated from one another so that they do not overlap portions of an adjacent working zone.

24. (Previously Presented) The overlay mark as recited in claim 20 wherein the working zones are configured to diminish the an impact of non-uniformities across the mark on tool and wafer induced shifts.

25. (Previously Presented) The overlay mark as recited in claim 20 wherein the pitch, period and duty cycle of the coarsely segmented elements is configured to balance the resolution of the a metrology used to image the overlay mark and the robustness of the process used to form the layers.

26. (Original) The overlay mark as recited in claim 20 wherein the coarsely segmented elements are parallel lines.

27. (Original) The overlay mark as recited in claim 20 wherein the relative shift between the first and second layers of the wafer is determined by comparing the relative positions of periodic structures on different layers.

28. (Cancelled)

29. (Currently Amended) The overlay mark as recited in claim [28] 20 wherein finely segmented elements are configured to provide shift information that more closely matches the relative shift between patterns of an integrated circuit formed on each of the two layers of the substrate.

30. (Currently Amended) An overlay mark for optically determining the a relative shift between two or more separately generated patterns on a single layer of a substrate, the overlay target comprising:

an optically discernable test region positioned on a first layer of the substrate, the first layer being formed by a first pattern via a first process and a second pattern via a second process;

a plurality of working zones positioned in the test region, the working zones being laterally spatially separated relative to one another, the working zones representing the actual areas of the test region that are used to determine the relative shift between the first and second patterns, wherein a first portion of the working zones are formed via the first process and a second portion of the working zones are formed via the second process;

a periodic structure positioned within each of the working zones, each of the periodic structures including a plurality of coarsely segmented elements, each of the coarsely segmented elements being formed by a plurality of finely segmented elements.

31. (Previously Presented) A method for determining the a relative shift between two or more successive layers of a substrate or between two or more separately generated patterns on a single layer of a substrate, the method comprising:

capturing an image of an overlay mark formed on the substrate, the overlay mark having a plurality of working zones, each of the working zones including a periodic structure of coarsely segmented elements and wherein the coarsely segmented elements are formed by a plurality of finely segmented elements;

selecting a plurality of working zones from the captured image, wherein at least one working zone from each layer or pattern is selected;

forming representative signals for each of the selected working zones, wherein at least one signal for each layer or pattern is formed; and

comparing the signal from a first layer or pattern to a signal from a second layer or pattern to determine the relative shift between different layers or patterns.

32. (Previously Presented) The method as recited in claim 31 wherein forming representative signals is accomplished by collapsing the 2D images of the working zones into 1D signals by averaging over X for Y-overlay calculations and by averaging over Y for X-overlay calculations.

33. (Original) The method as recited in claim 31 wherein comparing the signal from a first layer or pattern to a signal from a second layer or pattern to determine the relative shift between different layers or patterns is accomplished via a covariance-based overlay algorithm.

34. (Original) The method as recited in claim 31 wherein comparing the signal from a first layer or pattern to a signal from a second layer or pattern to determine the relative shift between different layers or patterns is accomplished via a Fourier Decomposition overlay algorithm.

35. (Cancelled)

36. (Previously Presented) The overlay mark as recited in claim 1 wherein the finely segmented elements are symmetrically positioned within the coarsely segmented elements of the periodic structures.

37. (Previously Presented) The overlay mark as recited in claim 14 wherein the dimensions of the finely segmented elements are similar to the dimensions of one or more device features of the integrated circuit.

38. (Previously Presented) The overlay mark as recited in claim 37 wherein the feature size and pitch of the finely segmented elements are substantially equal to the feature size and pitch of the device features.

39. (Previously Presented) The overlay mark as recited in claim 20 wherein the finely segmented elements are configured to mimic one or more device features formed on the substrate with the finely segmented elements.

40. (Previously Presented) The overlay mark as recited in claim 30 wherein the finely segmented elements are configured to mimic one or more device features formed on the substrate with the finely segmented elements.

41. (Previously Presented) The overlay mark as recited in claim 30 wherein the first portion of the working zones have at least two working zones diagonally opposed and spatially offset relative to one another, and the second portion of the working zones having at least two working zones diagonally opposed and spatially offset relative to one another, the first and second portions of the working zones lying crosswise relative to each other.

42. (Previously Presented) The method as recited in claim 31 wherein the finely segmented elements are configured to mimic one or more device features formed on the substrate with the

finely segmented elements.

43. (Currently Amended) A multidirectional overlay mark for optically determining the overlay between two separately generated patterns on a single or successive layers of a substrate, the multidirectional mark being separated into four quadrants that are optically discernable, each of the four quadrants including at least two separately generated working zones that are juxtaposed relative to one another and that together substantially fill the quadrant, the upper left quadrant including working zones configured to provide overlay information in a first direction, the upper right quadrant including working zones configured to provide overlay information in a second direction that is different than the first direction, the lower right quadrant including working zones configured to provide overlay information in the first direction, and the lower left quadrant including working zones configured to provide overlay information in the second direction.

44. (Previously Presented) The multidirectional overlay mark as recited in claim 43 wherein each of the working zones includes a periodic structure comprised of a plurality of coarsely segmented lines that substantially fills the perimeter of its corresponding working zone.

45. (Previously Presented) The multidirectional overlay mark as recited in claim 44 wherein the coarsely segmented lines of the periodic structures located within juxtaposed pairs of working zones are aligned with one another.

46. (Currently Amended) The multidirectional overlay mark as recited in claim 44 wherein the coarsely segmented lines are formed from a plurality of finely segmented elements configured to mimic one or more device features formed on the substrate with the plurality of finely segmented [[bars]] elements, the plurality of finely segmented elements being symmetrically positioned within each of the coarsely segmented lines.

47. (Previously Presented) The multidirectional overlay mark as recited in claim 43 wherein within the quadrants, the working zones located closer to a center of the overlay mark are generated concurrently and the working zones located further from the center of the overlay mark are generated concurrently.

48. (New) The overlay mark as recited in claim 1 wherein the coarsely segmented elements

are formed in their entirety from the plurality of finely segmented elements.

49. (New) The overlay mark as recited in claim 1 wherein the coarsely segmented elements are fully segmented by the finely segmented elements.

50. (New) The overlay mark as recited in claim 1 wherein the finely segmented elements are spread out evenly across the coarsely segmented lines.